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Technical report No. V-1144

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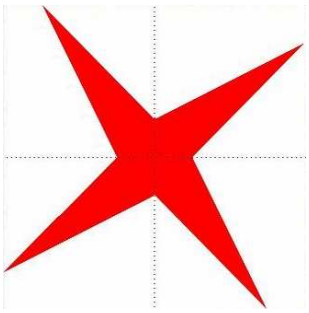
Abstract:

We disclose the file jks.m whose p-coded version is a part of the open source verification software package VERSOFT for computing verified singular value decomposition.



Keywords:
Singular value decomposition, verified result, interval arithmetic.[2]

[1]This work was supported by the Institutional Research Plan AV0Z10300504.

[2]Above: logo of interval computations and related areas (depiction of the solution set of the system $[2,4]x_1 + [-2,1]x_2 = [-2,2]$, $[-1,2]x_1 + [2,4]x_2 = [-2,2]$ (Barth and Nuding [1])).

1 Introduction

VERSOFT [2], a freely available verification software package written in INTLAB [3], a toolbox of MATLAB, contains as one of its pillars a p-coded (content-obscured) function `jk.p` for computing verified singular value decomposition (SVD) of a complex (or real) matrix. We make it here publicly available as a function `jks.m` (JK Shortened) in a compact form consisting of only 23 lines of the source code. The original function has been stripped off the output error variable `E` only, the rest has been kept intact.

2 Description

Here is the `help` of the function (not present in the compact source code):

```
function [U,S,V]=jks(A)
%    JKS        Verified thin singular value decomposition of a
%               complex (or real) matrix.
%
%    This is an INTLAB file. It requires to have INTLAB installed under
%    MATLAB to function properly.
%
%    For an m-by-n complex (or real) matrix A, m>=n,
%        [U,S,V]=jks(A)
%    computes (generally complex) m-by-n interval matrix U, a real diagonal
%    n-by-n interval matrix S and an n-by-n interval matrix V that are verified
%    to contain matrices Uo, So, Vo satisfying (in exact arithmetic):
%        A=Uo*So*Vo',
%        Uo'*Uo=eye(n,n),
%        Vo'*Vo=eye(n,n),
%        So has nonnegative diagonal entries ordered in nonincreasing order.
%    Hence, Uo, So and Vo form a thin singular value decomposition (SVD) of A.
%    If A is real, then U and V are real. For s=diag(S), both s.inf and s.sup
%    are nonnegative and ordered in nonincreasing order. If no verified
%    output is given, then U, S and V consist of NaN's.
%
%    If m<n, then the decomposition is computed by
%        [U1,S1,V1]=jks(A');
%        U=V1; S=S1'; V=U1;
%    so that U, S are m-by-m and V is n-by-m and the above properties again
%    hold, this time with
%        Uo'*Uo=eye(m,m),
%        Vo'*Vo=eye(m,m).
%
%    Copyright 2008-2011 Jiri Rohn.
```

3 Download

The source file can be downloaded from
http://uivtx.cs.cas.cz/~rohn/matlab/others/jks.m.
It calls a subfunction `ols.m` which can be found at
http://uivtx.cs.cas.cz/~rohn/matlab/others/ols.m.

Dedication

Dedicated to J. K.-Z. after whom the file was named.

Bibliography

[1] W. Barth and E. Nuding, *Optimale Lösung von Intervallgleichungssystemen*, Computing, 12 (1974), pp. 117–125. 1

[2] J. Rohn, *VERSOFT: Verification software in MATLAB/INTLAB*, 2009. http://uivtx.cs.cas.cz/~rohn/matlab. 2

[3] S. Rump, *INTLAB - INTerval LABoratory*, in Developments in Reliable Computing, T. Csendes, ed., Kluwer Academic Publishers, Dordrecht, 1999, pp. 77–104. http://www.ti3.tu-harburg.de/rump/. 2